

Planetary Science Division Status Report

James L. Green

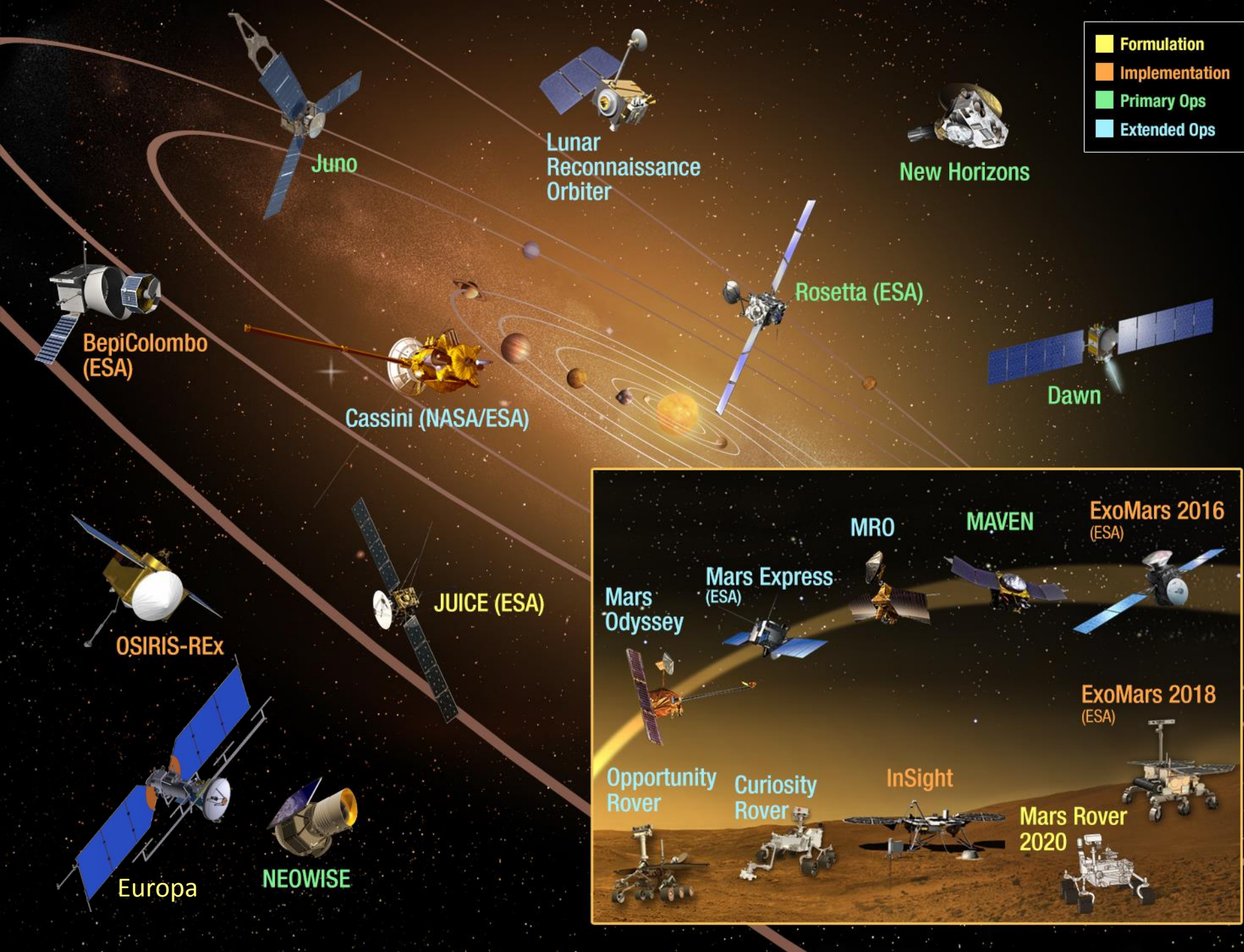
NASA, Planetary Science Division

December 8, 2015

Presentation to Planetary Protection Subcommittee

Outline

- Mission Overview
- Discovery & New Frontiers Programs
- Mars Exploration Program (J. Watzin)
- Europa mission
- New Cubesat Selections
- Initiate New Studies



Planetary Science Missions Events

2014

- July – *Mars 2020* Rover instrument selection announcement * Completed
- August 6 – 2nd Year Anniversary of *Curiosity* Landing on Mars
- September 21 – *MAVEN* inserted in Mars orbit
- October 19 – Comet Siding Spring encountered Mars
- September – *Curiosity* arrives at Mt. Sharp
- November 12 – ESA's *Rosetta* mission lands on Comet Churyumov–Gerasimenko
- December 2/3 – Launch of *Hayabusa-2* to asteroid 1999 JU₃

2015

- March 6 – *Dawn* inserted into orbit around dwarf planet Ceres
- April 30 – *MESSENGER* spacecraft impacted Mercury
- May 26 – Europa instrument Step 1 selection
- July 14 – *New Horizons* flies through the Pluto system
- September – Discovery 2014 Step 1 selection
- December 7 – *Akatsuki* inserted into orbit around Venus

2016

- March – Launch of ESA's *ExoMars Trace Gas Orbiter* & Launch of NASA's *InSight*
- July 4 – *Juno* inserted in Jupiter orbit
- September – *InSight* Mars landing
- September – Launch of Asteroid mission *OSIRIS-REx* to asteroid Bennu
- September – *Cassini* begins to orbit between Saturn's rings & planet
- Late 2016 – Discovery 2014 Step 2 selection

Status of Discovery Program

Discovery 2014 – [Selections announced September 30](#)

- About 3-year mission cadence for future opportunities

Missions in Development

- *InSight*: Launch window opens March 4, 2016 (Vandenberg)
- Strofio: Delivered to SERENA Suite (ASI) for BepiColombo

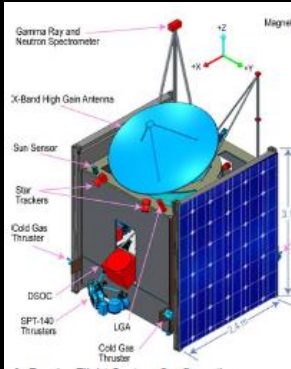
Missions in Operation

- *Dawn*: Moving into the low altitude mapping orbit

Missions in Extended Operations

- *MESSENGER*: Completed low altitude science operations before impact with Mercury
- *LRO*: In stable elliptical orbit, passing low over the lunar south pole

Discovery Selections



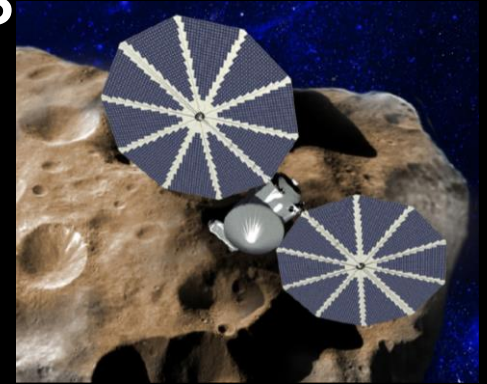
Psyche: Journey to a Metal World
 PI: Linda Elkins-Tanton, ASU
 Deep-Space Optical Comm (DSOC)



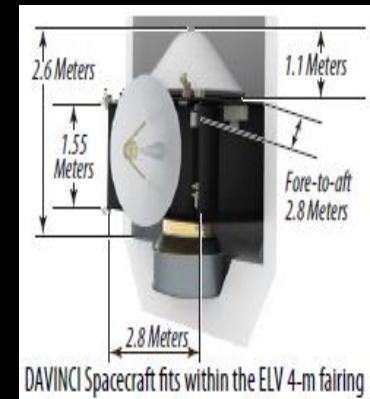
NEOCam:
 Near-Earth Object Camera
 PI: Amy Mainzer, JPL
 Deep-Space Optical Comm (DSOC)



VERITAS: Venus Emissivity, Radio Science, InSAR, Topography, And Spectroscopy
 PI: Suzanne Smrekar, JPL
 Deep-Space Optical Comm (DSOC)



Lucy: Surveying the Diversity of Trojan Asteroids
 PI: Harold Levison, Southwest Research Institute (SwRI)
 Advanced Solar Arrays



DAVINCI: Deep Atmosphere Venus Investigations of Noble gases, Chemistry, and Imaging
 PI: Lori Glaze, GSFC



Status of New Frontiers Program

Next New Frontiers AO Status

- New ROSES call for instrument/technology – completed
- Community announcement in preparation

Missions in Development - OSIRIS REx

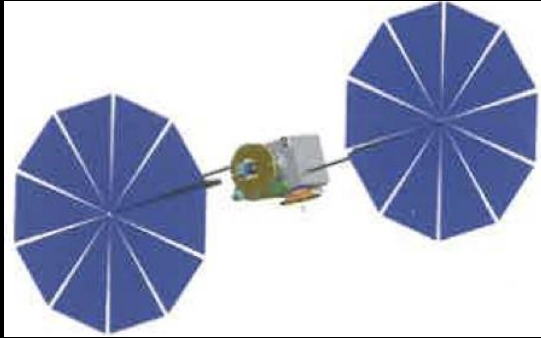
- Launch in Sept 2016 & encounter asteroid Bennu in Oct 2018
- Operate at Bennu for over 400 days
- Returns a sample in 2023 that scientists will study for decades with ever more capable instruments and techniques.

Missions in Operation

- New Horizons:
 - Highly successful Pluto system encounter July 14, 2015
 - NH now targeted to Kuiper Belt object 2014 MU69
- Juno:
 - Spacecraft is ~5.2 AU from the sun and ~0.7 AU from Jupiter
 - Orbit insertion is July 4, 2016

New Frontiers #4 Focused Missions

Comet Surface
Sample Return



Lunar South Pole
Aitken Basin Sample
Return



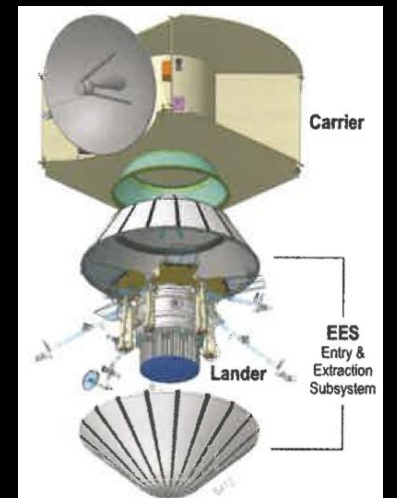
Trojan Tour &
Rendezvous



Saturn Probes



Venus In-Situ Explorer

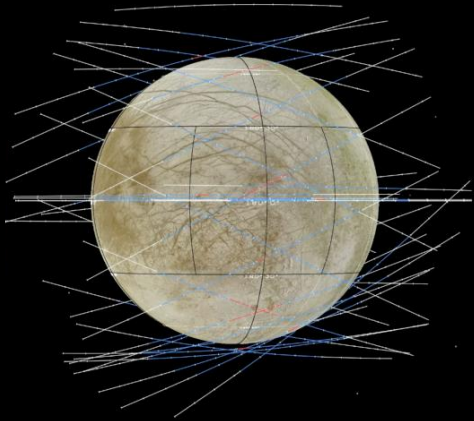


RPS Mission Planning

<div> <div> <div>Strategic</div> <div>New Frontiers</div> <div>Discovery</div> </div> <div> <div>Mars</div> <div>Lunar</div> <div>Other</div> </div> </div>		Projected Launch Year	Power Reqmnt (W _e)	RPS Type (Flight + Spare)	Pu-238 Availability
Mars Science Lab	Operational	2011	100	1 MMRTG	Yes
Mars 2020	In Development	2020	120	1 MMRTG + Spare	Yes
New Frontiers 4	In Planning	2024	300	3 MMRTG/ eMMRTG	Yes
New Frontiers 5	Notional	2030	300	TBD	Requires new

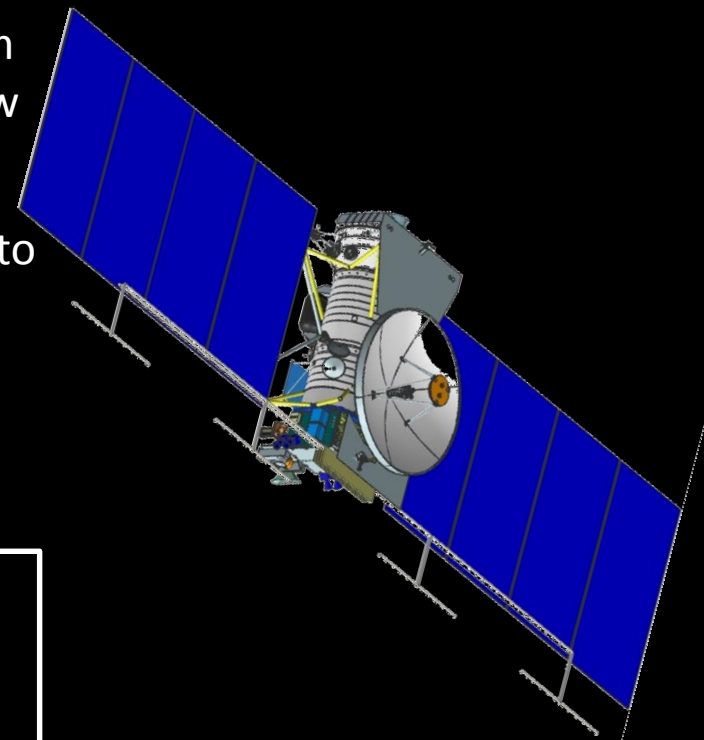
- Potential 5-6 year-cadence for New Frontier mission opportunities
 - RPS not required for all mission concepts
- Radioisotope heater units may be used on missions that do not require RPS
- Strategic missions often require RPS; highest priority strategic missions in current decadal (Mars 2020 and Europa) are already in work
 - Mars 2020 will use an MMRTG
 - Europa mission will be solar powered

Europa Multi-Flyby Mission Concept Overview



Science	
Objective	Description
Ice Shell & Ocean	Characterize the ice shell and any subsurface water, including their heterogeneity, and the nature of surface-ice-ocean exchange
Composition	Understand the habitability of Europa's ocean through composition and chemistry.
Geology	Understand the formation of surface features, including sites of recent or current activity, and characterize high science interest localities.
Recon	Characterize scientifically compelling sites, and hazards for a potential future landed mission to Europa

- Conduct 45 low altitude flybys with lowest 25 km (less than the ice crust) and a vast majority below 100 km to obtain global regional coverage
- Traded enormous amounts of fuel used to get into Europa orbit for shielding (lower total dose)
- Simpler operations strategy
- No need for real time down link



Key Technical Margins

*37 - 41%
Mass

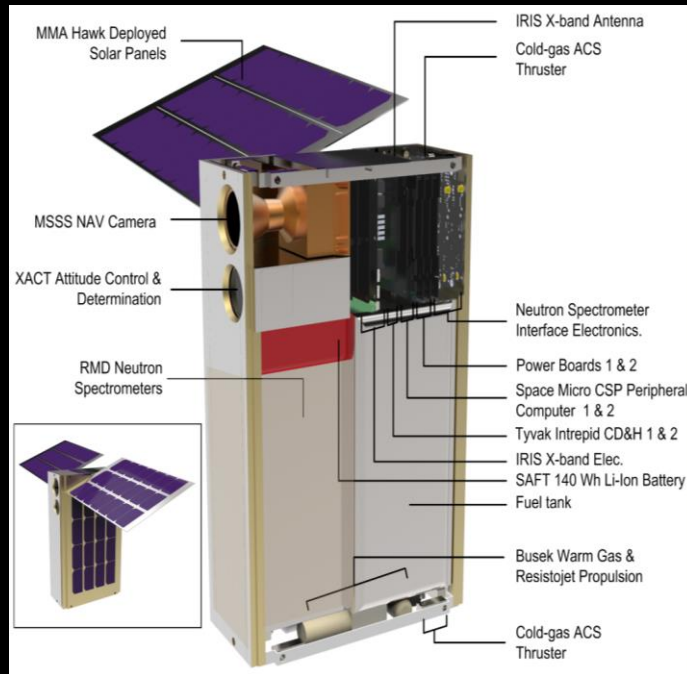
40%
Power

* Depends on Launch Opportunity and Launch Vehicle

Simplex Cubesats

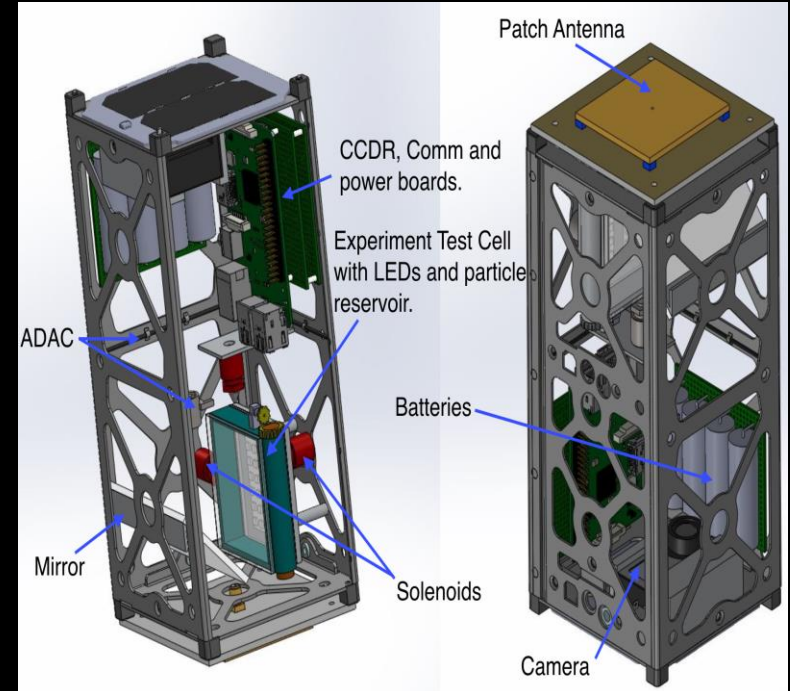
Approved for Tech Development (1 year) Study ONLY

Small Innovative Missions for Planetary Exploration (SIMPLEx-2014) – New Awards in FY15



Lunar Polar Hydrogen Mapper (LunaH-Map)

PI: Craig Hardgrove
ASU School of Earth and Space Exploration

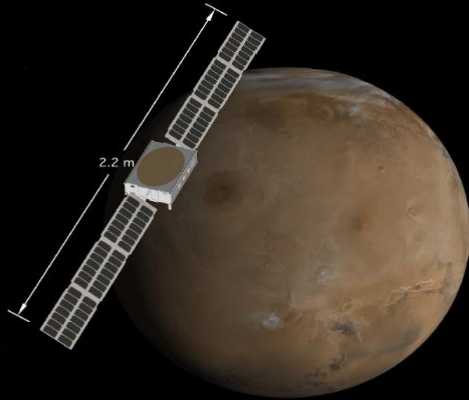


CubeSat Particle Aggregation and Collision Experiment (Q-PACE)

PI: Josh Colwel
University of Central Florida

Simplex Cubesats

Approved for Tech Development (1 year) Study ONLY



Mars Micro Orbiter

PI: Michael Malin

Malin Space Science Systems

Diminutive Asteroid Visitor using Ion Drive (DAVID)

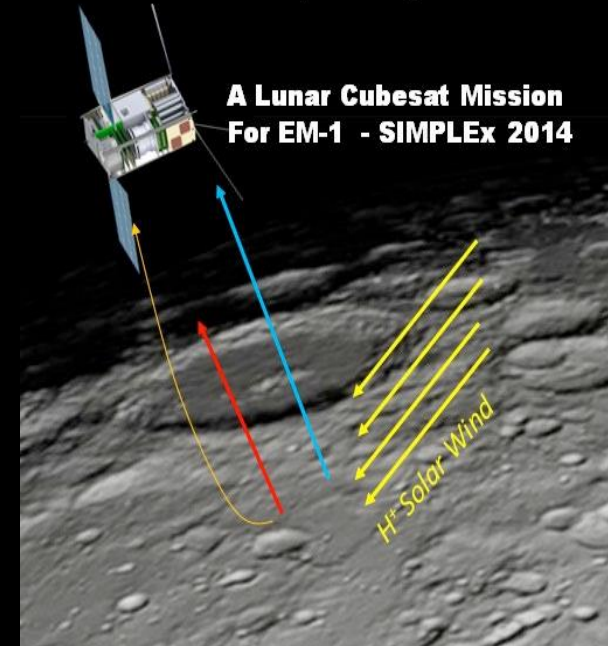
PI: Geoffrey Landis

NASA Glenn Research Center



Hydrogen Albedo Lunar Orbiter (HALO)

A Lunar Cubesat Mission
For EM-1 - SIMPLEx 2014



Hydrogen Albedo Lunar Orbiter (HALO)

PI: Michael Collier,
NASA GSFC

Initiate New Studies

National Academy R&A Study

Objective: Examine the program elements of the PSD R&A programs, as they currently exist following restructuring, for their consistency with past NRC advice.

The committee will address the following questions:

1. Are the PSD R&A program elements appropriately linked to, and do they encompass the range and scope of activities needed to support, the NASA Strategic Objective for Planetary Science and the PSD Science Goals, as articulated in the 2014 *NASA Science Plan*?
2. Are the PSD R&A program elements appropriately structured to develop the broad base of knowledge and broad range of activities needed both to enable new spaceflight missions and to interpret and maximize the scientific return from existing missions?

Ice Giants Study

- Initiate an Ice Giants Study assigned to JPL
- Goal: Assess science priorities and affordable mission concepts & options in preparation for the next Decadal Survey
- Objectives:
 - Identify mission concepts that can address science priorities based on what has been learned since the 2013-2022 Decadal
 - Identify potential concepts across a spectrum of price points
 - Identify enabling/enhancing technologies
 - Assess capabilities afforded by SLS

Study Ground-Rules

- Address both Uranus and Neptune Orbiters
- Target cost range NTE \$2B (FY15\$) per mission
- Technical aspects to investigate:
 - Determine pros/cons in using one spacecraft design for both missions (possibility of joint development of two copies)
 - Evaluate use of realistic emerging enabling technologies: distinguish mission specific vs. broad applicability
 - Constrain missions to fit on a commercial LV
 - Identify benefits/cost savings if SLS were available (e.g., time, trajectory...)
- Identify clean-interface roles for potential international partnerships
- Establish a Science Definition Team (SDT)
 - ESA has been invited to provide team members

Asteroid Impact & Deflection Assessment (AIDA)

- AIDA is a mission concept to demonstrate asteroid impact hazard mitigation with a kinetic impact spacecraft to deflect an asteroid
- AIDA would be a joint NASA and ESA mission with 2 parts:
 - European rendezvous spacecraft, the Asteroid Impact Monitor (AIM) mission
 - NASA kinetic impactor, the Double Asteroid Redirection Test (DART) mission
- NASA has agreed with ESA to enter parallel formulation concept (pre-Phase A) studies
- The AIDA mission would intercept the secondary member of the binary near-Earth asteroid 65803 Didymos in Oct. 2022

Questions?



Image by john doe